Overview of Marine Aquaculture in the Northeast U.S.: Current Status and Future Prospects

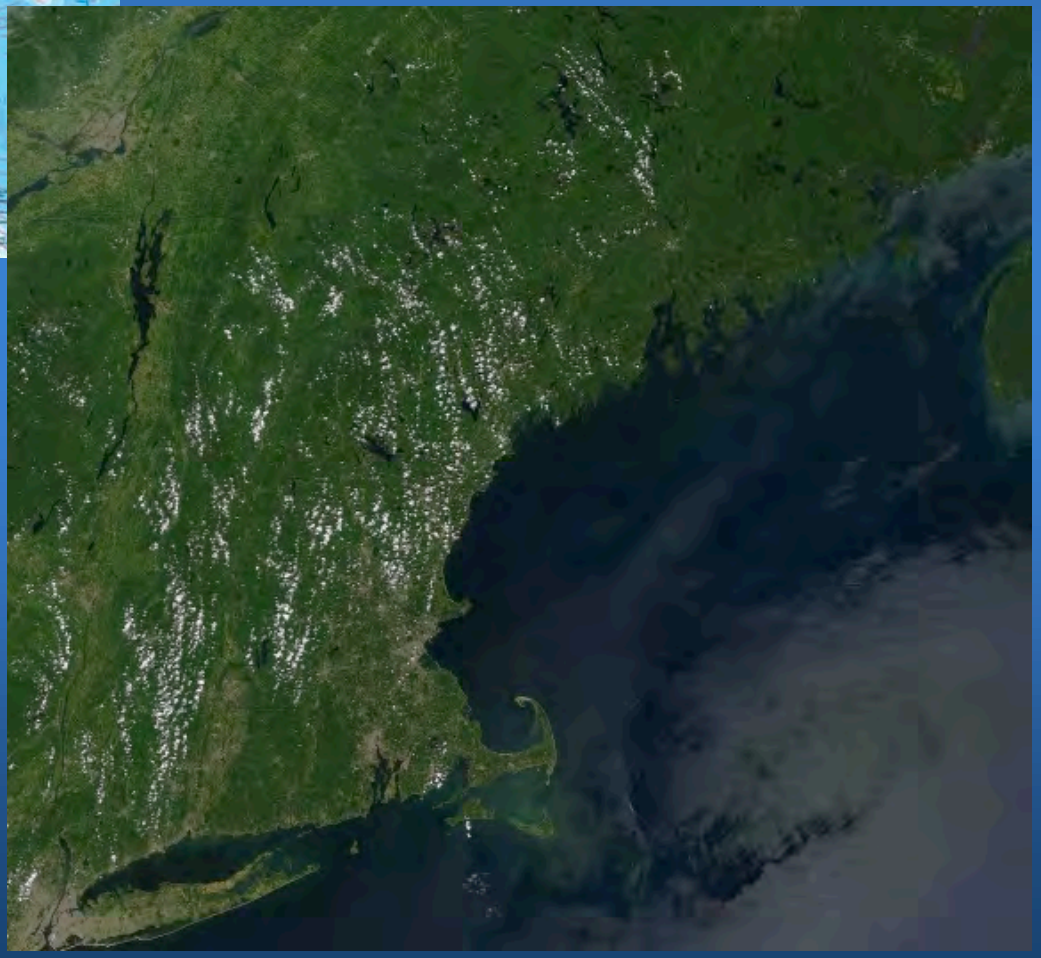
Richard Langan, University of New Hampshire

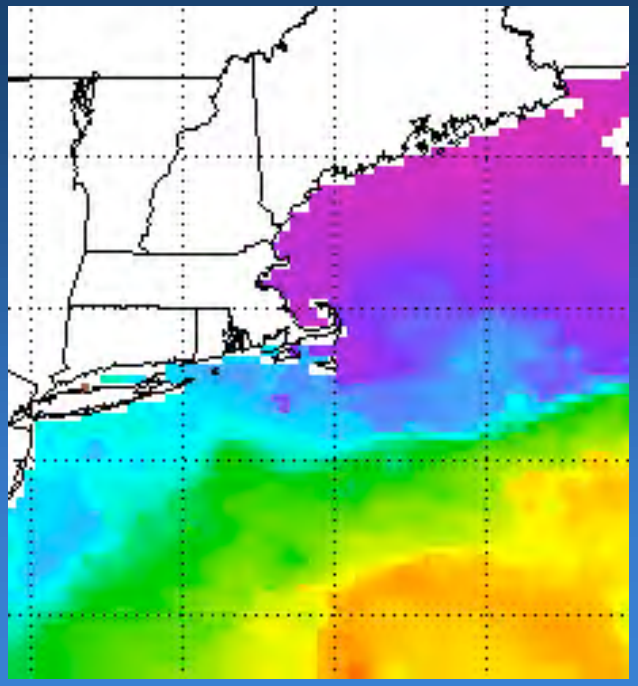
Presentation Outline

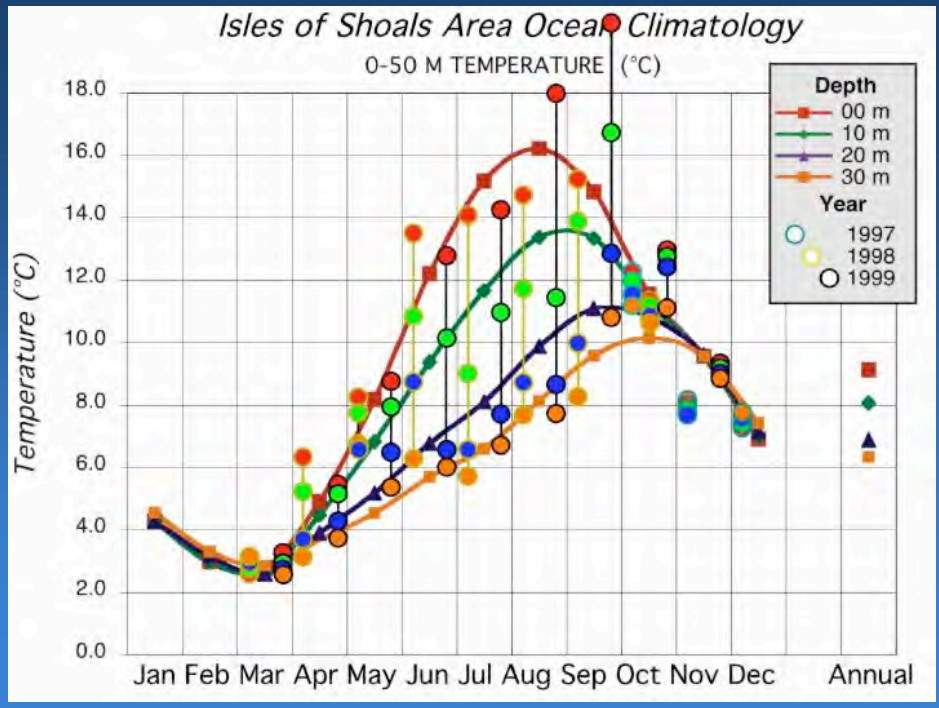
- *Regional Environmental Conditions*
- *Historical Perspective of Fisheries*
- *Industry Sectors*
    - *Species and methods*
    - *Economic Impact and trends*
- *Research Initiatives*
- *Aquaculture and resource enhancement*
- *Prospects for the future*

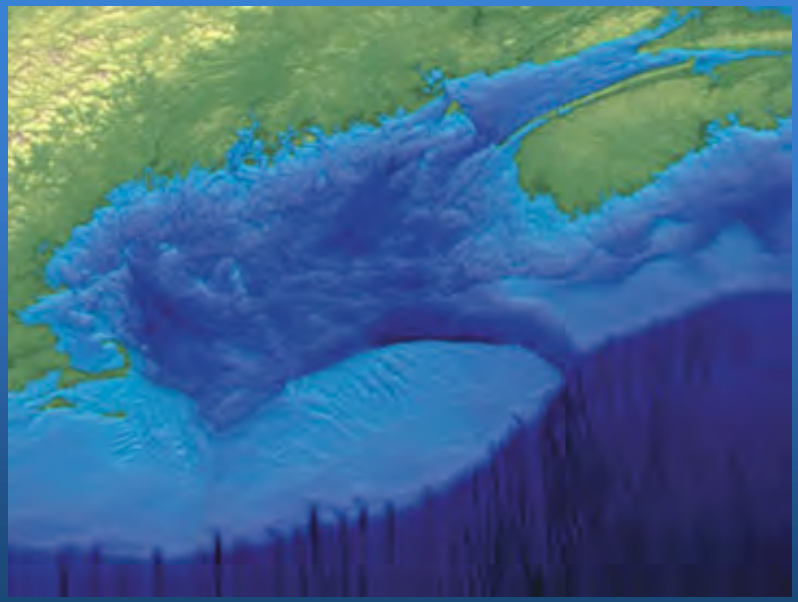
    Opportunities and Challenges

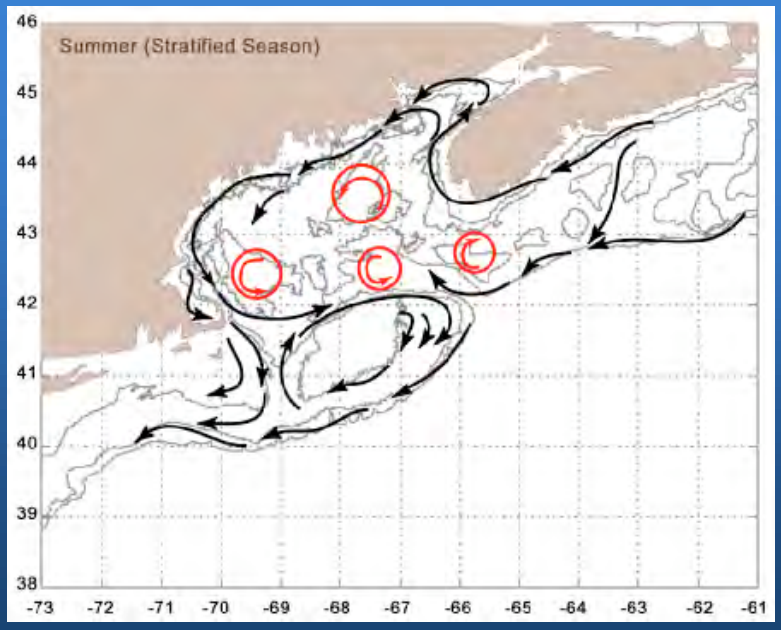

Beaufort Sea
Chukchi Sea
Baffin Bay
Greenland
Hudson Bay
Labrador
Gulf of Alaska
Gulf of Mexico
P A C I F I C



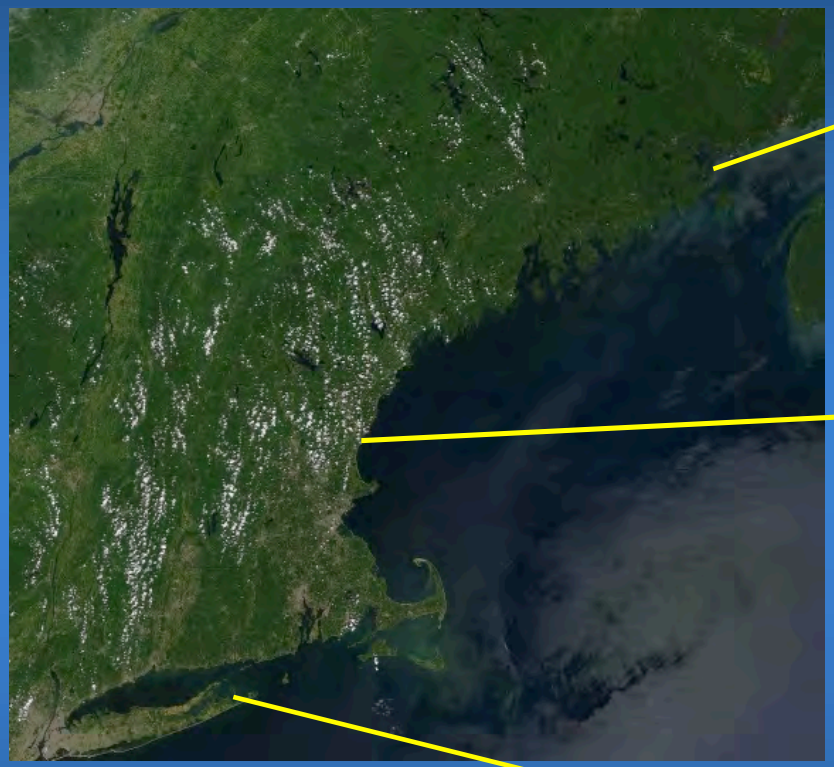



Isles of Shoals Area Ocean Climatology
0-50 M TEMPERATURE (°C)
Temperature (°C)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Annual
Depth
00 m
10 m
20 m
30 m
Year
1997
1998
1999




Summer (Stratified Season)
46
45
44
43
42
41
40
39
38
-73 -72 -71 -70 -69 -68 -67 -66 -65 -64 -63 -62 -61

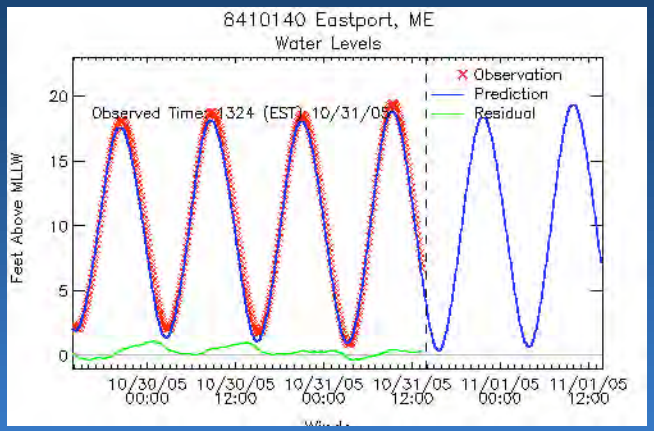
Tidal Amplitude

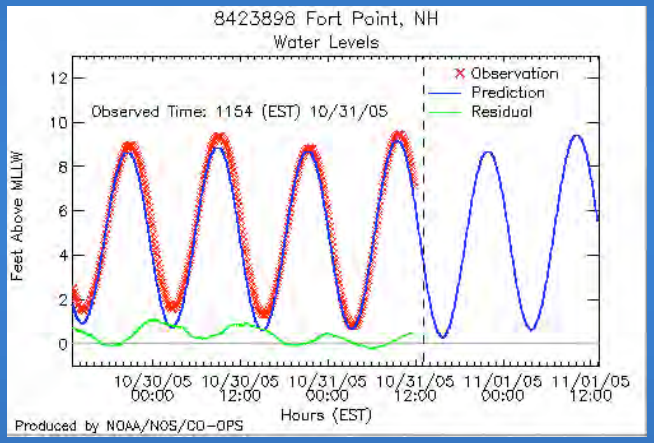


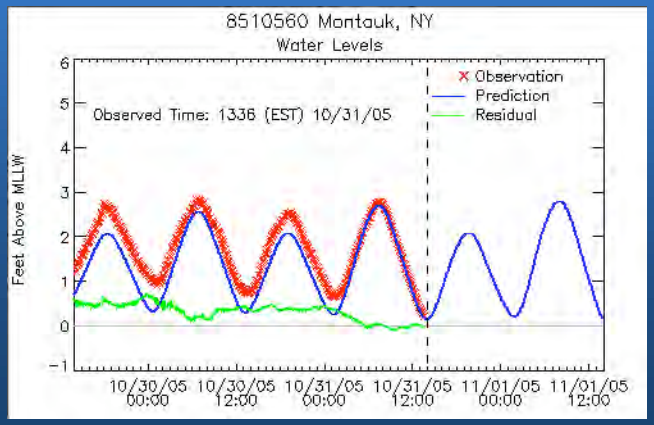
6 m

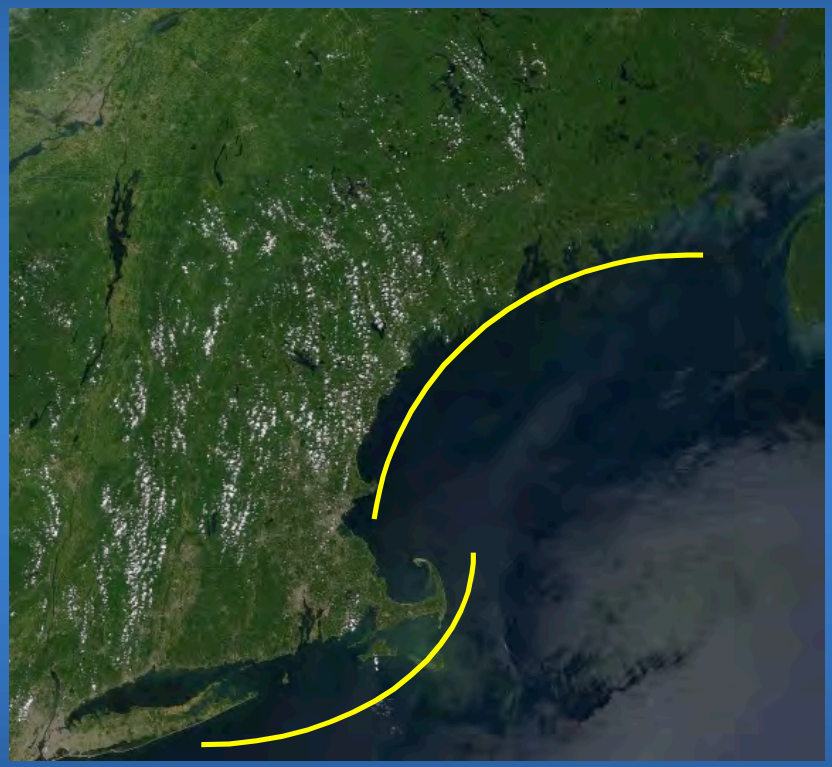
2.6 m

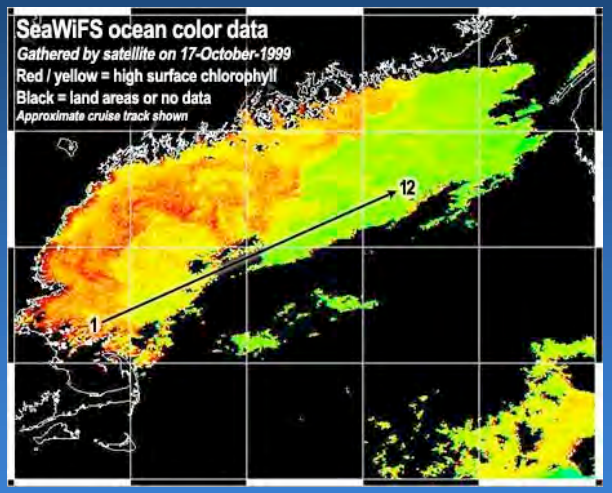
1.5 m

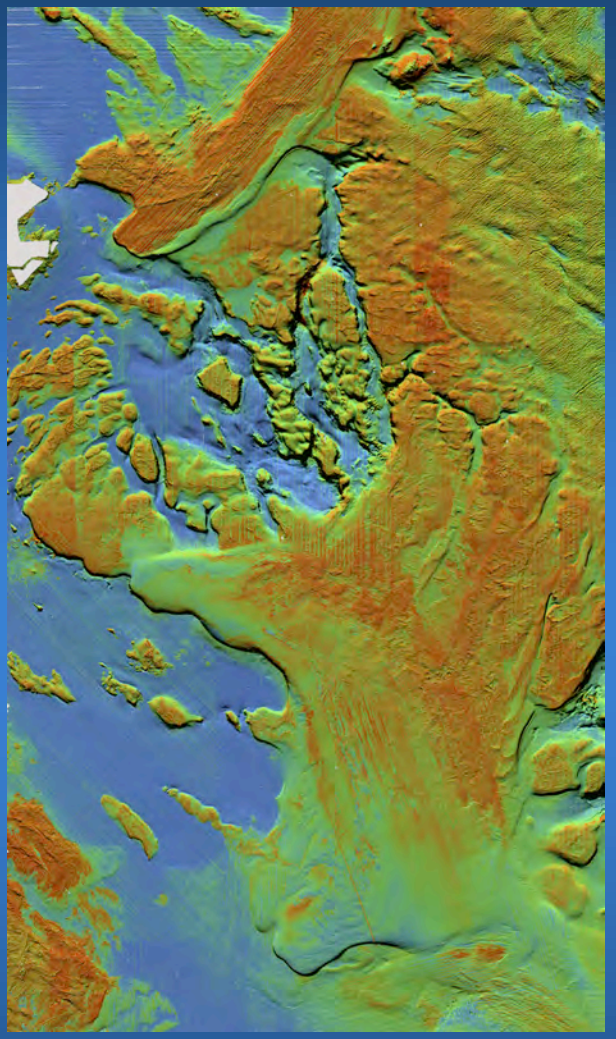


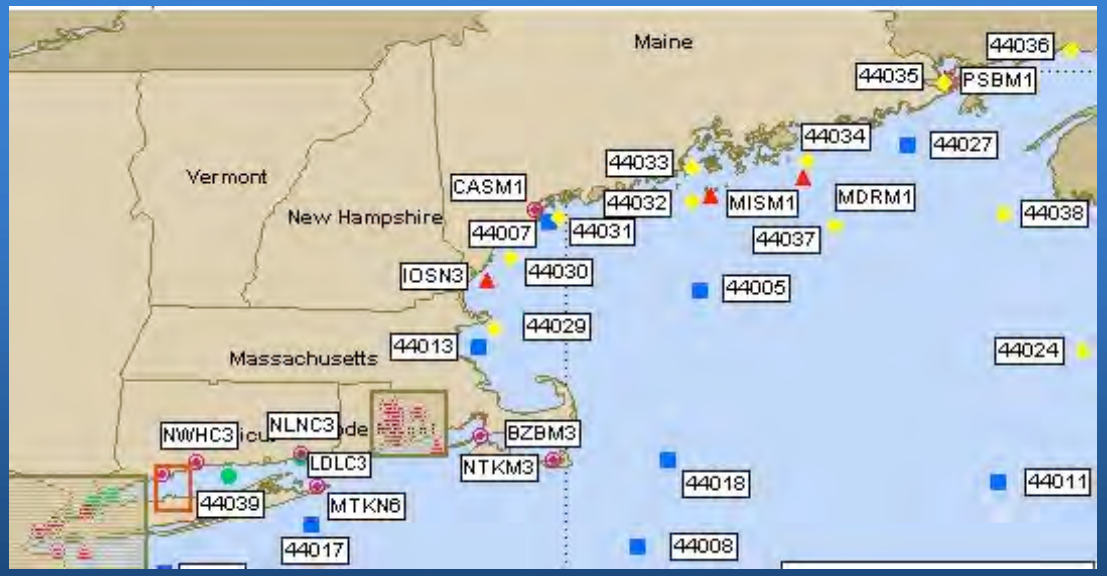







SeaWiFS ocean color data
Gathered by satellite on 17-October-1999
Red / yellow = high surface chlorophyll
Black = land areas or no data
Approximate cruise track shown
1
12




Maine
Vermont
New Hampshire
Massachusetts
44036
44035
PSBM1
44034
44027
44033
CASM1
44032
MISM1
MDRM1
44038
44007
44031
44037
IOSN3
44030
44005
44029
44013
44024
NWHC3
NLNC3
BZBM3
LDLC3
NTKM3
44039
MTKN6
44018
44011
44017
44008


MONTREAL
OTTAWA
TORONTO
BUFFALO
ALBANY
BOSTON
NY/NJ AREA

Historical Fisheries Perspective

- *Bountiful Natural Marine Resources- abundance and variety*
- *Fisheries were the first industries to develop*
- *Vital to regional and national economies*
- *Decline during 20th century*
- *Stocks in a highly depressed state*
- *Severe restrictions- economic hardship*
- *Need for aquaculture development*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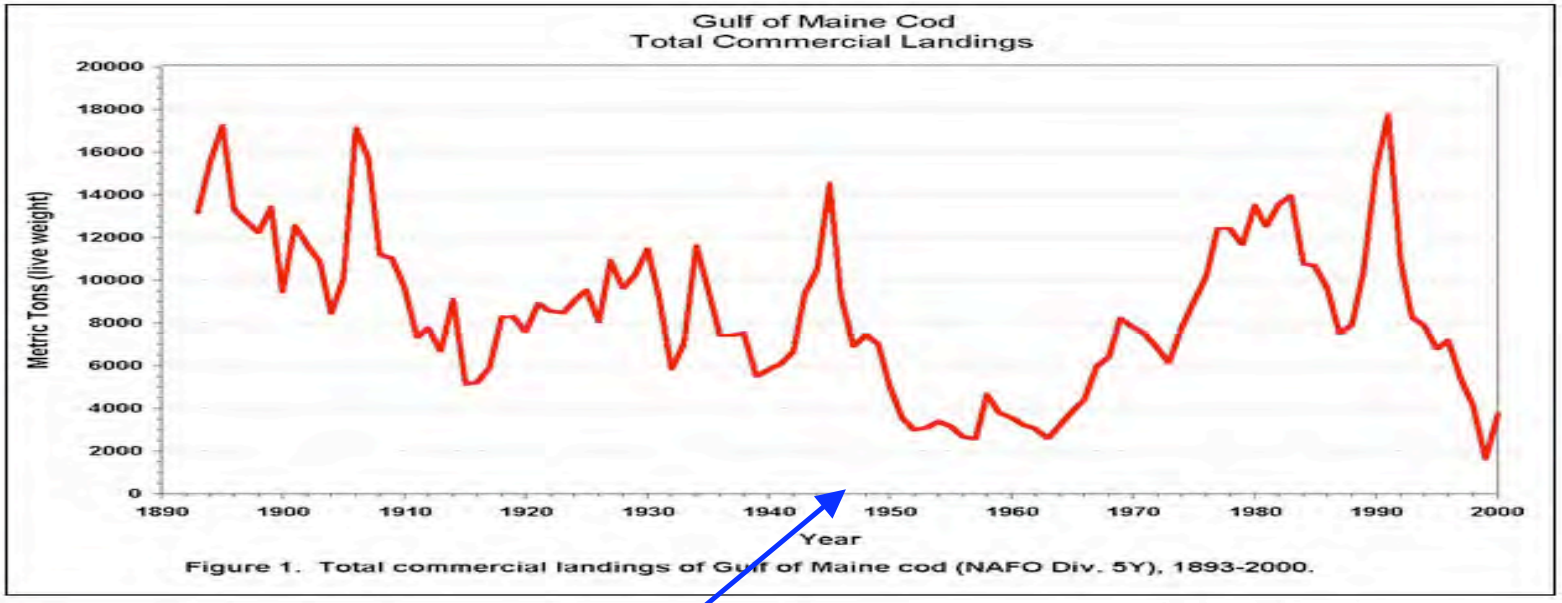


Figure 1. Total commercial landings of Gulf of Maine cod (NAFO Div. 5Y), 1893-2000.

Cod Landings

Cod Biomass

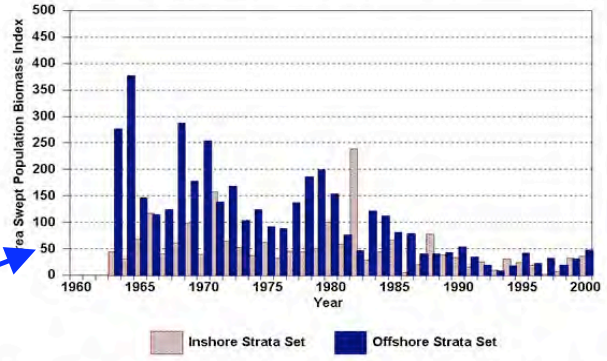


Figure 8. Swept area weighted biomass indices (Stratified mean weight per tow) for Gulf of Maine cod based on inshore (strata 26 and 27) and offshore (strata 28-30 and 36-40) regions from NEFSC autumn bottom trawl surveys.

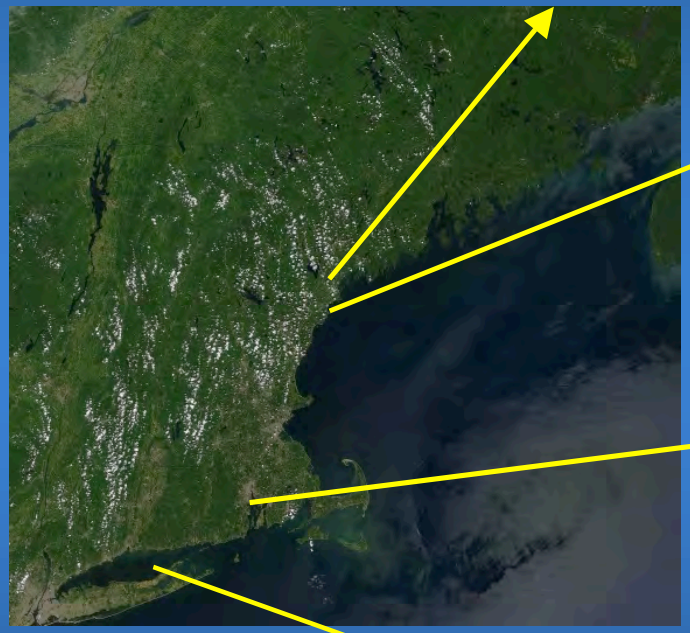
Regional Policy and Regulatory Structure for Marine Aquaculture

- ***Regulatory framework for federal waters in development***
- ***Controlled by individual states inshore of 3 NM***
  - ***Jurisdiction, regulatory landscape,fees and acceptance are highly variable***
- ***Permitting process complex, redundant and costly***
- ***Stakeholder and public input is influential***
- ***Molluscan shellfish has achieved greater acceptability***
- ***Finfish cage culture has become very controversial***

Industry Sectors

- ***Molluscan Shellfish***
  - ***Intensive and Extensive***
  - ***Bottom and Suspension Culture***
- ***Finfish***
  - ***Land based***
  - ***Near shore cages***
  - ***Offshore Cages***
- ***Other***
  - ***Sea Urchin, sea vegetables, sea worms***

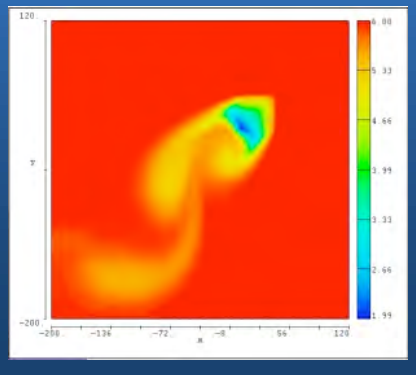
Molluscan Shellfish Culture




Oyster Schooners Working on NJ Seedbeds of Delaware Bay

Shellfish Industry Characteristics

- *Highly Diverse*
- *Individuals to larger companies*
- *Several acres to hundreds of acres*
- *Discrete Sector to Vertically Integrated*
- *Low Tech to High Tech*
- *Niche products to commodity*
- *Innovation in production methods*
- *Alternative for commercial fishermen*
- *Applied science in action*



Molluscan Shellfish Species

- Oysters
  - Eastern (C.virginica)
  - Belon (O. edulis)
- Clams
  - Quahog (M. mercenaria)
  - Softshell (M. arenaria)
- Mussels
  - Blue (M. edulis)
- Scallops
  - Bay (A. irradiens)
  - Sea (P. megallanicus)

Oyster Culture Methods

- Larval Supply
  - Natural- NY, CT
  - Hatchery- NY, MA, ME

- Seed Production
  - Natural Settlement
  - Hatchery Production
  - Single seed, clusters

Oyster Culture (cont'd)

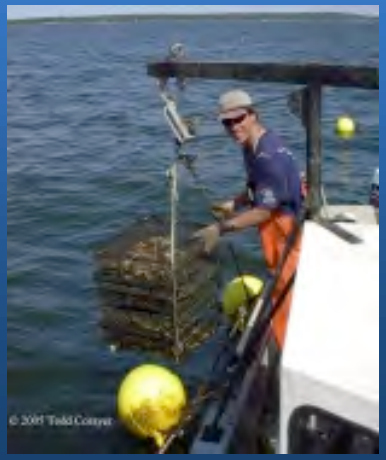
- *Nursery*

  Upwellers, Bagged shell with attached seed

- *Growout*

  On Bottom

  Containment and suspension



Regional Oyster Culture Summary

- *Number of Farms* — *120*
- *Number of Hatcheries* — *18*
- *Total Production* — *36 M*
- *Total farm gate value* — *$15 M*
- *Leading producers NY, CT, MA, ME*

Clam Culture

Hard Clam-culture

Softshell- enhancement

- ***Hatchery production of larvae and seed***
- ***Upwellers for nursery culture***
- ***Growout on bottom with predator netting***

Regional Oyster Culture Summary

- *Number of Farms* — *200*
- *Number of Hatcheries* — *30*
- *Total Production* — *200 M*
- *Total farm gate value* — *$24 M*
- *Leading producers NY, CT, MA, ME*

Mussel Culture

- *Larval and Seed Supply*

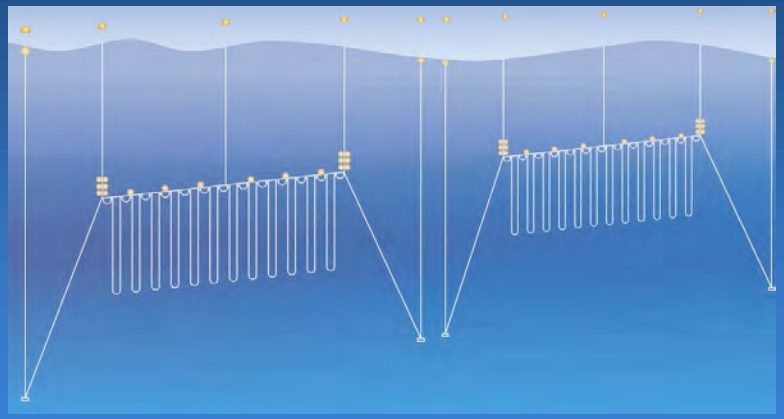
  Natural production

- *Growout*

  Bottom culture

  Ropes or sleeves suspended from rafts, surface longlines, and submerged longlines

Submerged Longlines - open ocean opportunities



http:// ooa.unh.edu

Regional Mussel Culture Summary

- *Number of Farms* — *18*
- *Number of Hatcheries* — *0*
- *Total Production* — *< 2 M kg*
- *Total farm gate value* — *$2 M*
- *Leading producer ME*

Scallop Culture

- Larval and seed production
  - Hatchery techniques well developed for bay scallop
  - Sea scallop culture relies on wild caught seed
- Growout- Experimental
  - Containment in cages and nets
  - Bottom Culture
  - Restoration and enhancement (bay scallops)

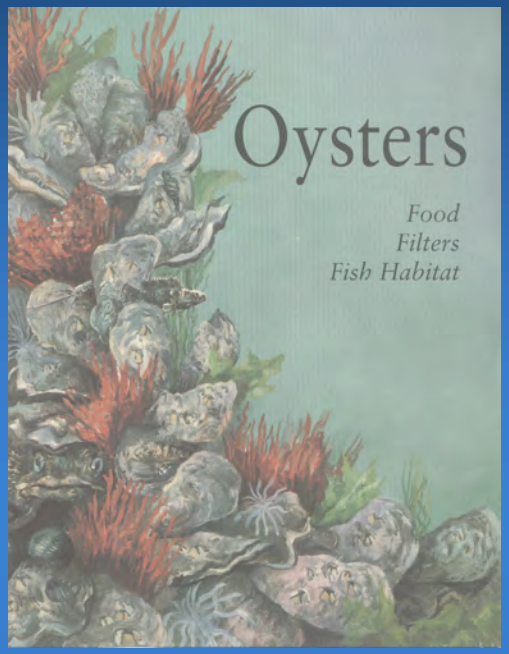
Economic Impacts and Trends

Farm Gate Value (2004)		Trend
All species	$ 41 M	⇕
Oysters	$ 15 M	⇕
Clams	$ 24 M	⇔
Mussels	$ 2 M	⇓
Scallops	$ N/A	

Shellfish Culture and the Environment

Documented Environmental Benefits

- ***No external Feed Source***
- ***Improves Water Clarity***
- ***Provides Valuable Habitat***
- ***Removes Nitrogen***
- ***Improves Oxygen Conditions***



Ecosystem Management Tool

- ***Improves restoration success***
- ***Mitigate the Impacts of eutrophication***
- ***Pollution credit trading***
- ***Integrated Aquaculture***

Limiting Factors to Industry Growth

- *Coastal Pollution*
- *Competing Uses (incl. viewscapes)*
- *Disease*
- *Harmful Algal Blooms*
- *Biofouling (incl invasives)*
- *Predation*

Marine Finfish Culture

- ***Land-based culture***

  Flow through and recirculating systems

  Species-flounder, barramundi, halibut (exp)

  Limited by land, labor and energy costs

- ***Sea cage culture***

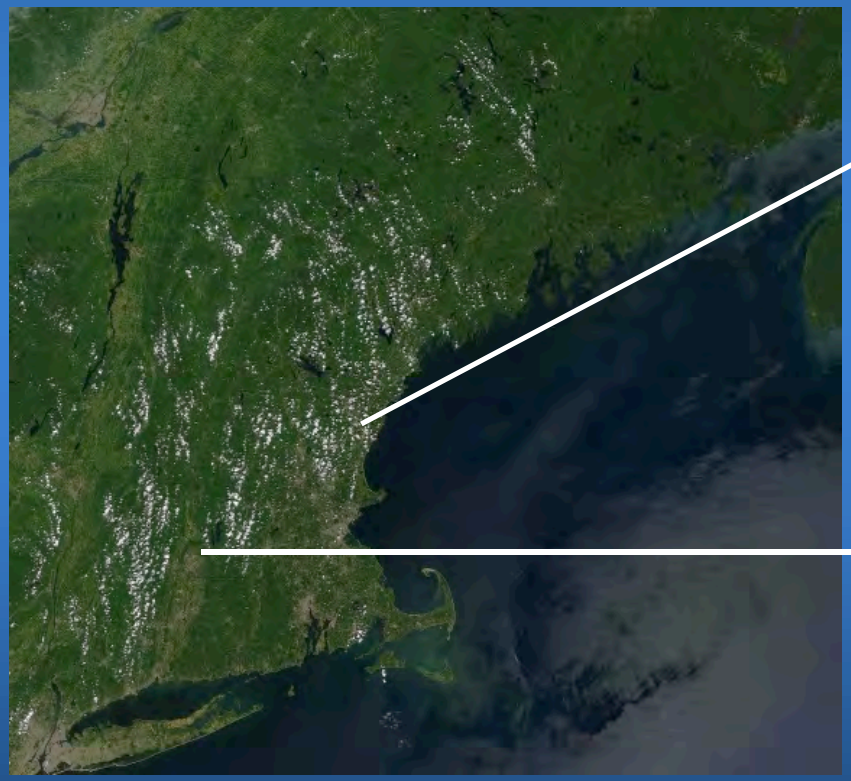
  Land based hatchery and nursery

  Nearshore, floating pens- Atlantic salmon, steelhead trout

  Offshore, submersible sea cages,cod, halibut, haddock, (exp)

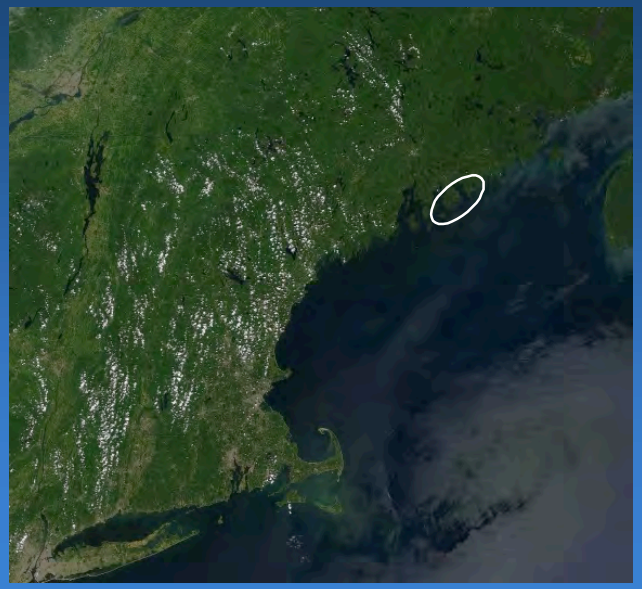
Land-based Culture

Flounder, halibut (planned)



Barramundi

Atlantic Salmon Culture

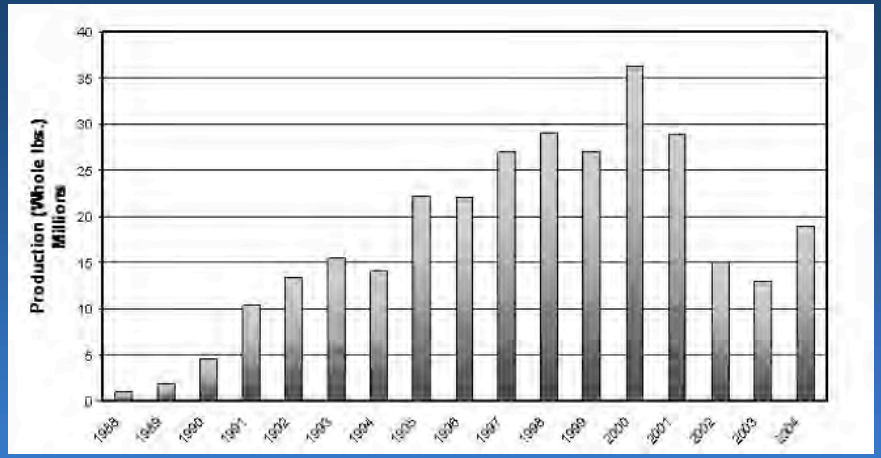


- Production in Maine began in late 1960s-companies started small& many - ended up large and few

- Hatchery and nursery in land based systems (freshwater)

- Farms located in protected, nearshore waters

Peak production in 2000 (> 16 M kg), declined to 8 M kg in 2004



Number of farm sites has declined from 29 in 2000 to 15 in 2004

Why??

Competition, disease, lawsuits, regulatory constraints, ESA

and….

Farmed and Dangerous

Quick Links | Go

CAAR
Coastal Alliance for Aquaculture Reform

farmed and dangerous

Think Twice About Eating Farmed Salmon

Sign up for Action Alerts and our e-newsletter!

your email

Subscribe Unsubscribe Do it

- About CAAR
- Farming Issues
- Action Center
- Media Room
- Reports
- Information Gallery
- Farmed Free Restaurants and Retailers near you
- FAQs
- Links
- Contact Us

TAKE ACTION!

Store Finder - Give us your postal/zip code and we will give you the address for Safeway and Whole Foods locations nearest you along with a PDF you can print and bring to them to let them know they should stop selling farmed salmon

Smarten Up Safeway! - Send a fax to Safeway asking them to stop selling farmed salmon

New! Spotlight on Farmed Salmon Free Restaurants - Learn more about the chefs and restaurants behind the decisions to stop selling farmed salmon

Salmon farming is bad for the environment

Imagine the raw sewage that half a million people would create in one day. It is probably too much to imagine. Now imagine if it were pumped directly into the ocean without having been treated. There are presently over 85 open net cage fish farms currently operating in the coastal waters of British Columbia producing waste that is equivalent in impact to the raw sewage from a city with 500,000 inhabitants. It could get a lot worse if industry is allowed to add new farms. More...

Help!

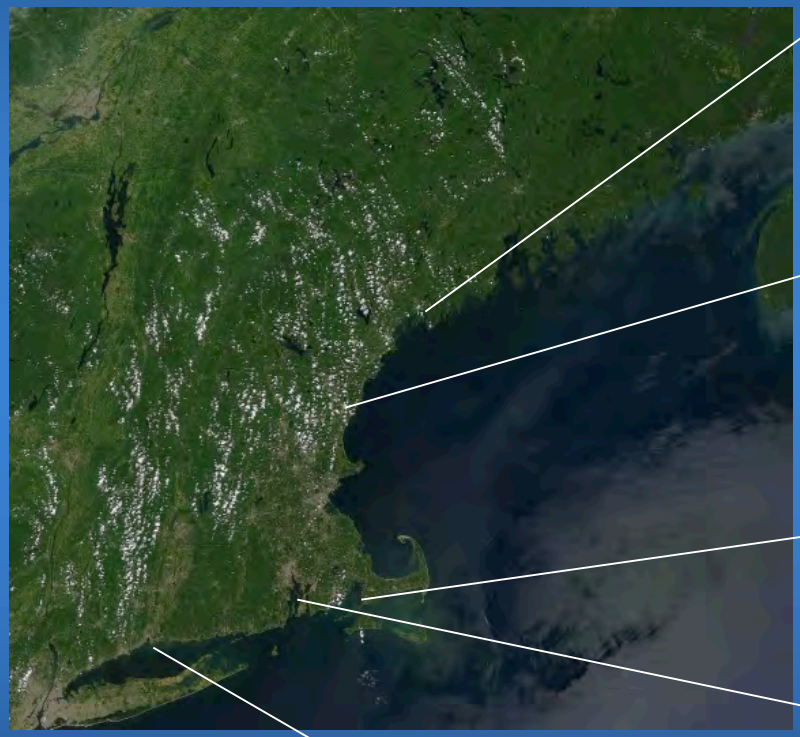
In order to keep doing the work CAAR is doing, we sure could use your financial support. If you are able to make a contribution to our work, **contact us** to find out how or send cheque payable to The Living Oceans Society 207 West

NEW!

Farmed and Dangerous launches a corporate campaign against retailer giant Safeway, urging them to stop selling farmed salmon

Excellent New Book Out: Exposes Truth About Salmon Aquaculture: *A Stain Upon the Sea* is a must-read for anyone concerned with the quality of the food they eat and the environmental health of the planet

Research Efforts and Emerging Sectors



University of Maine, US Dept of Agriculture, and Industry Partners

University of New Hampshire, NOAA, and Industry partners

Woods Hole Oceanographic Institution and Marine Biological Laboratory

University of Rhode Island and Industry Partners

NOAA, NMFS Milford Laboratory, University of Connecticut

NOAA, NMFS Milford Laboratory, University of Connecticut

Microalgal culture, molluscan shellfish rearing, sea bass, Nori culture

University of Rhode Island and Industry Partners

Cod and haddock reproduction (with Univ. of New Hampshire, fish health, ecological aquaculture, mollusc culture

Woods Hole Oceanographic Institution and Marine Biological Laboratory

Molluscan shellfish culture, shellfish diseases,

offshore technologies (with Univ. of New Hampshire)

University of Maine, US Dept of Agriculture, and Industry Partners

Salmon reproduction

Cod reproduction

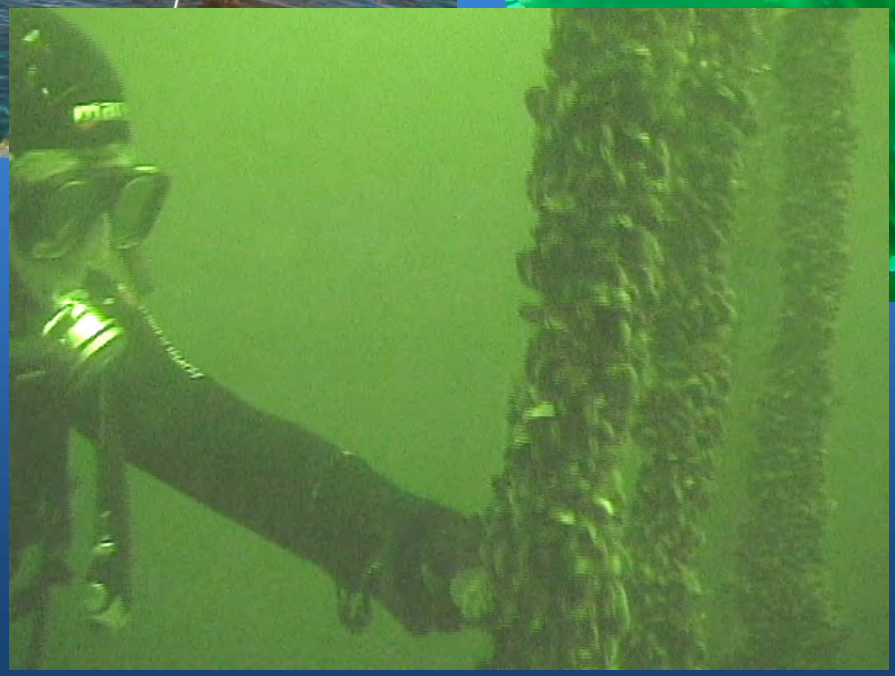
Halibut reproduction and juvenile rearing

Sea Urchins, Nori

Sea worms: Seabait, Ltd.

Univ. of NH, NOAA, Institutional and Industry Partners

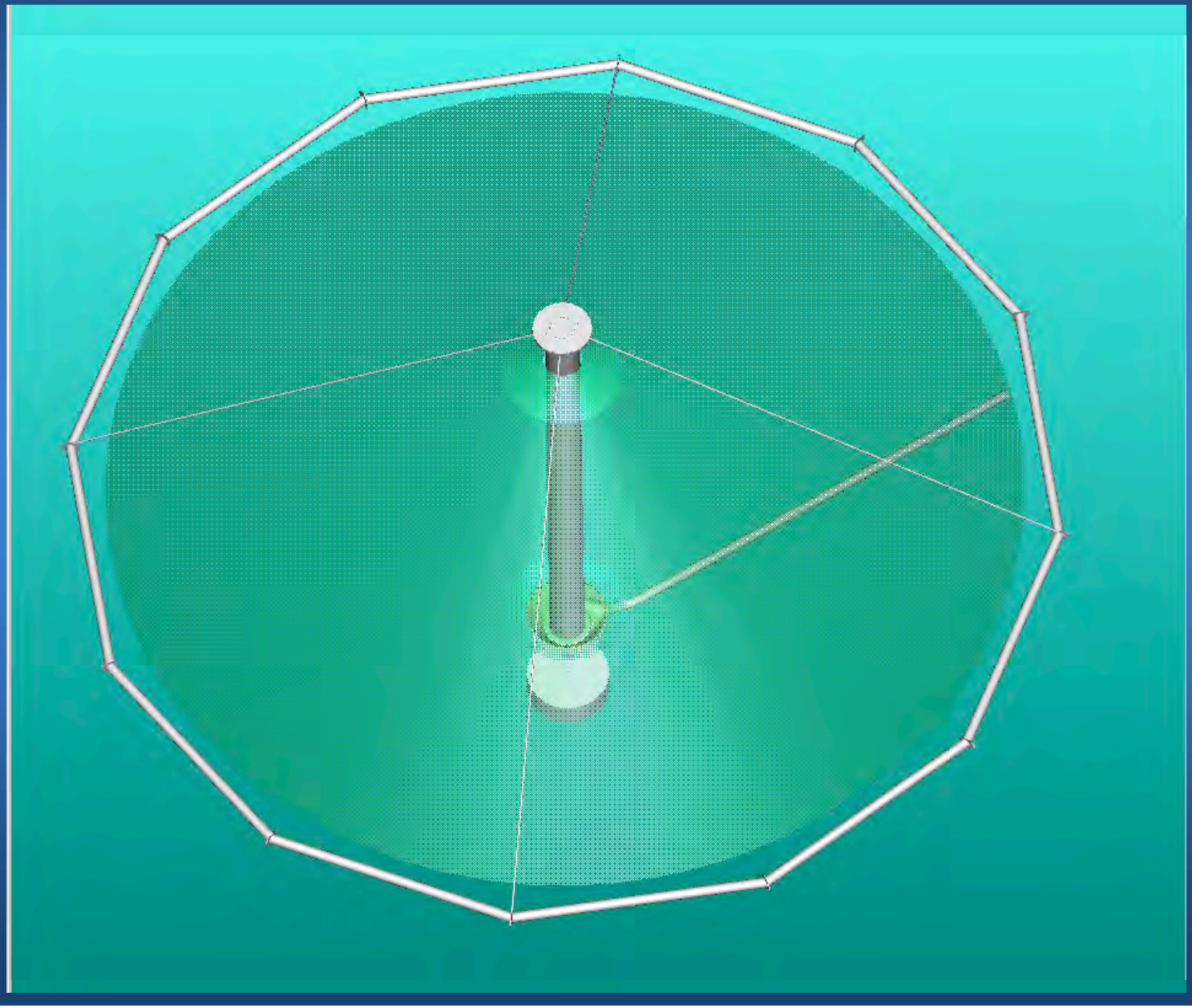
Open Ocean Aquaculture

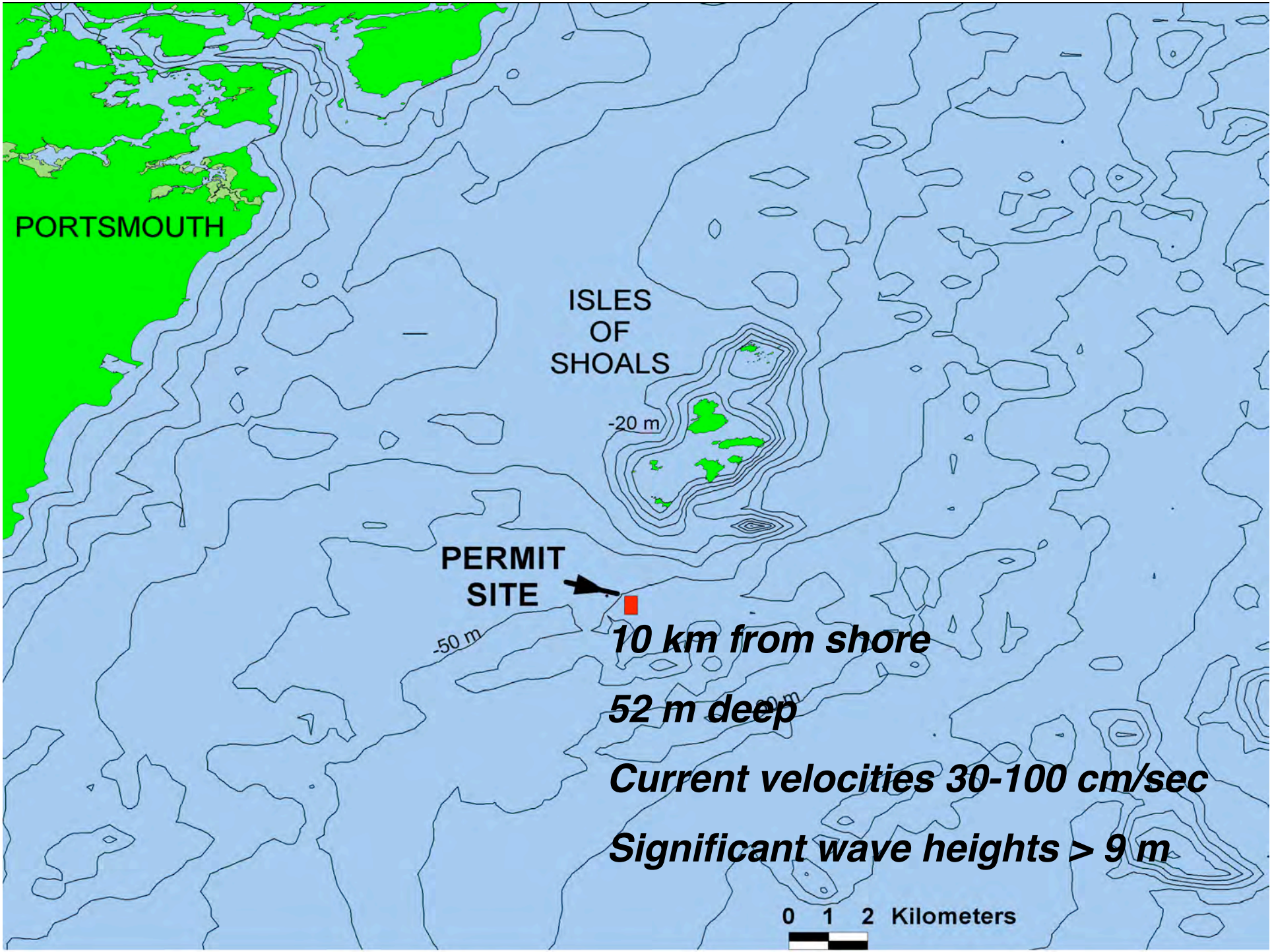


Rationale for Developing Offshore Aquaculture

- *Expansion of Marine Aquaculture is Needed*
- *Due to constraints on nearshore protected waters, expansion will likely take place offshore*
- *Potential to reduce environmental impacts*
- *Better environment for the cultured organisms*
- *Tremendous carrying capacity*
- *Significant technological advances are making the move offshore a possibility*
- *Significant technological challenges*
- *Economic Risk not well known*

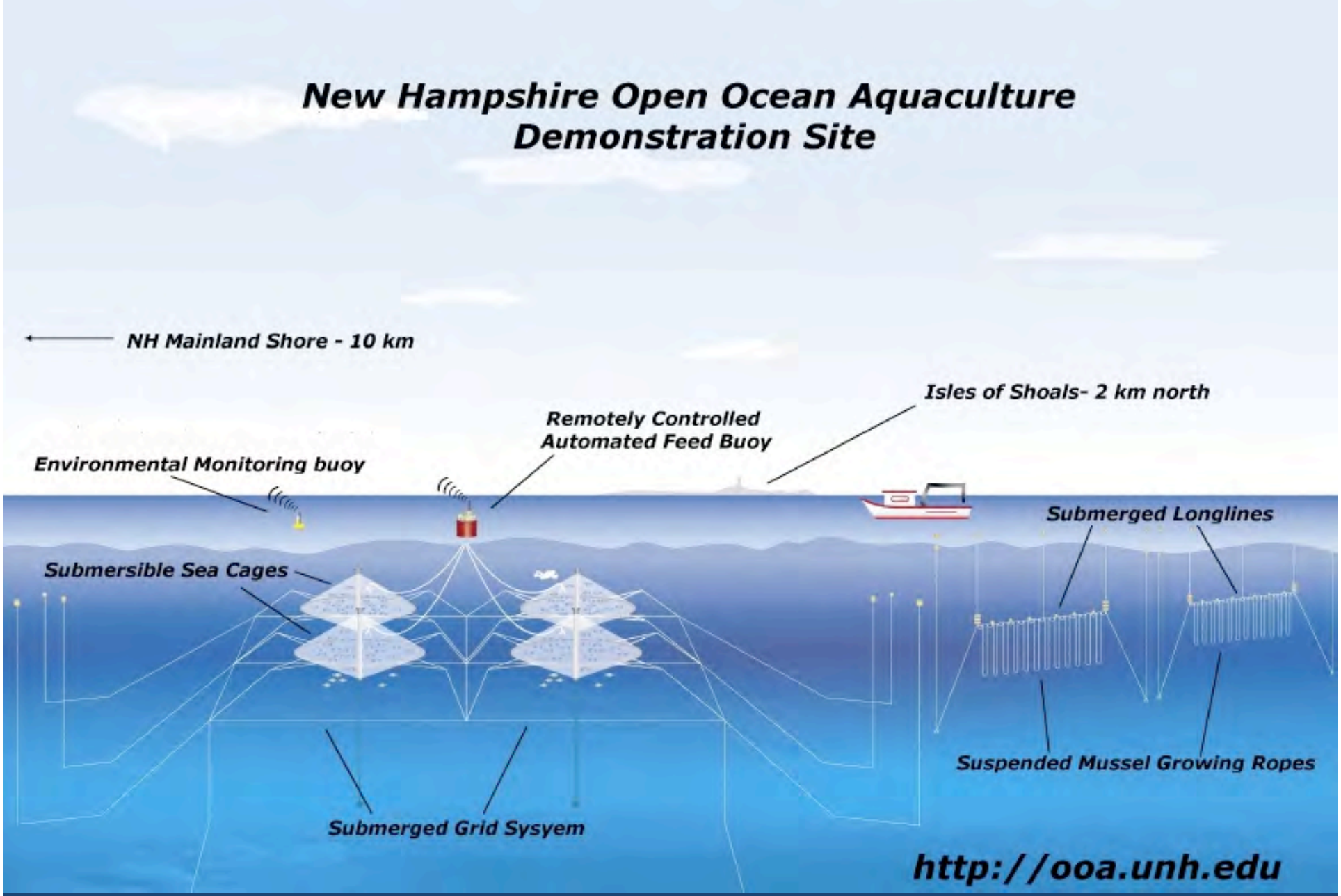
Ocean Spar Sea Station

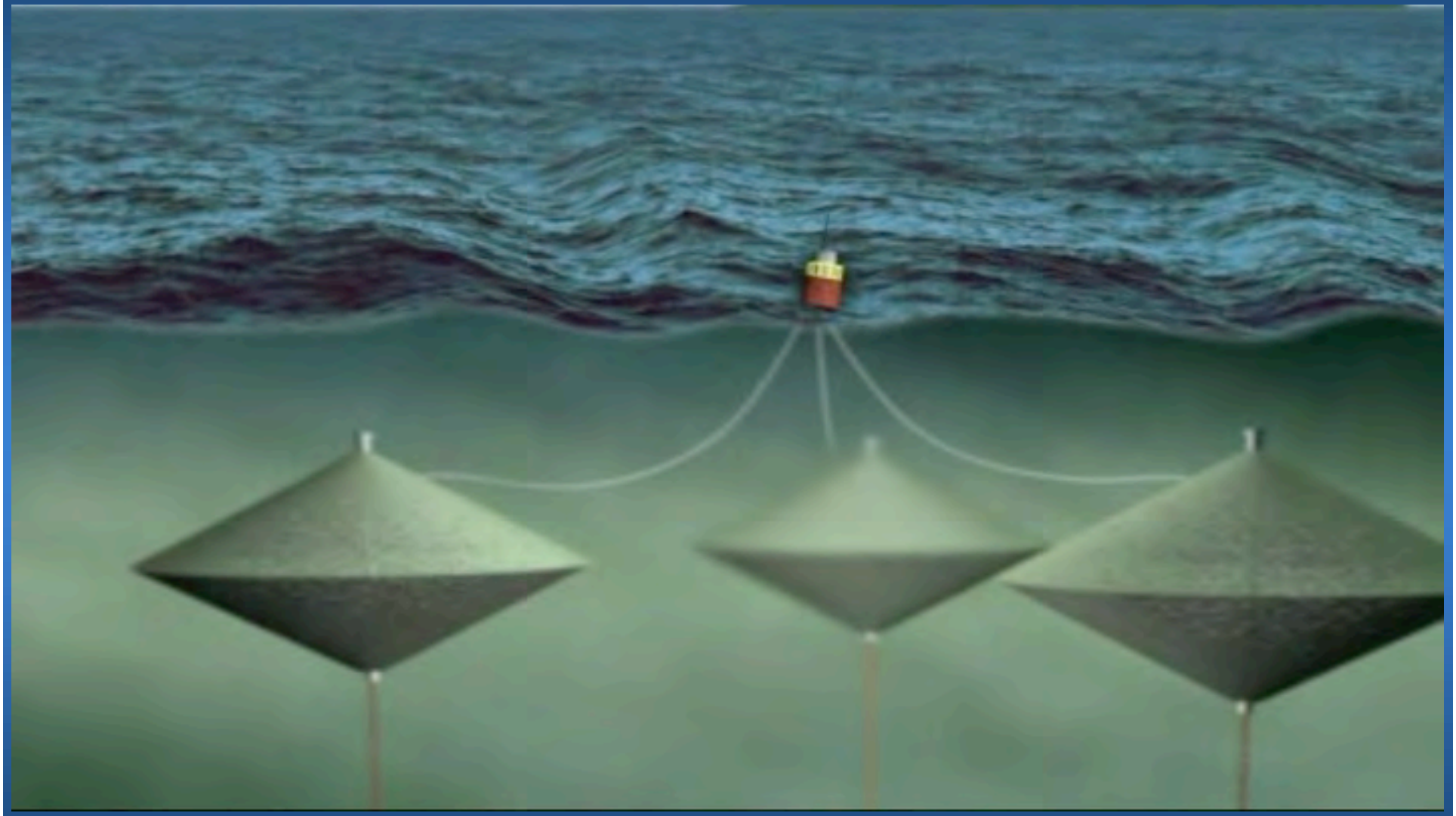



PORTSMOUTH
ISLES
OF
SHOALS
-20 m
PERMIT
SITE
-50 m
10 km from shore
52 m deep
Current velocities 30-100 cm/sec
Significant wave heights > 9 m
0 1 2 Kilometers

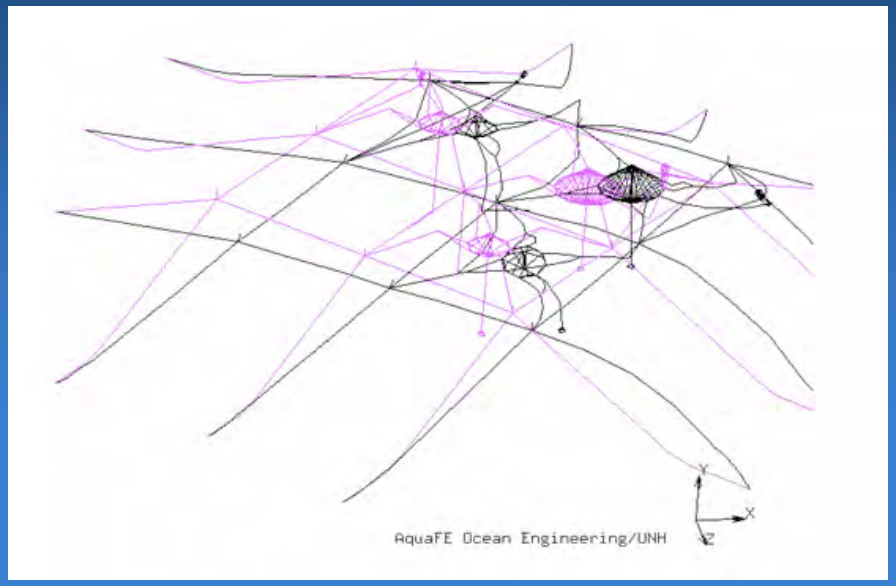

DANGER

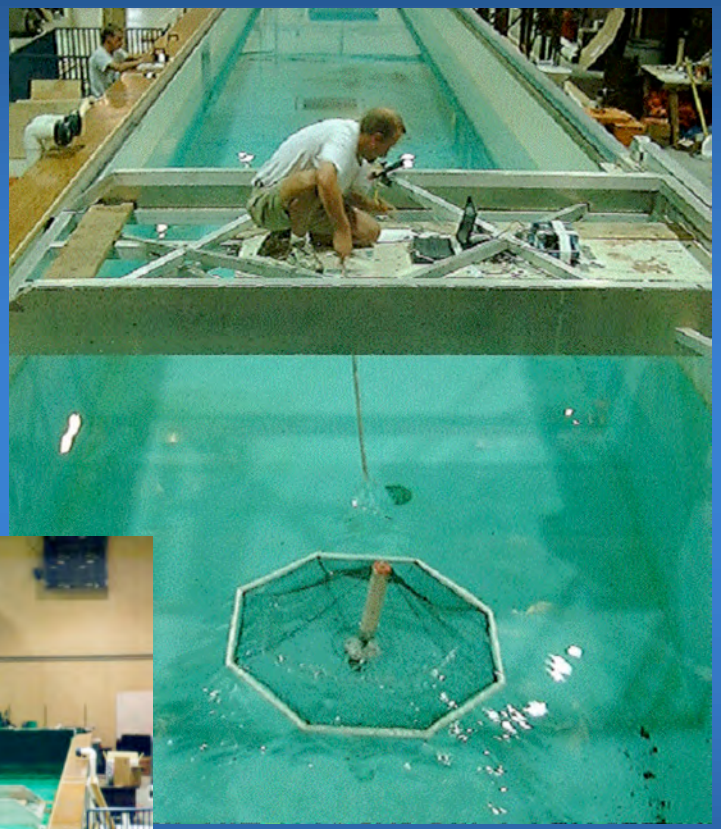
New Hampshire Open Ocean Aquaculture Demonstration Site

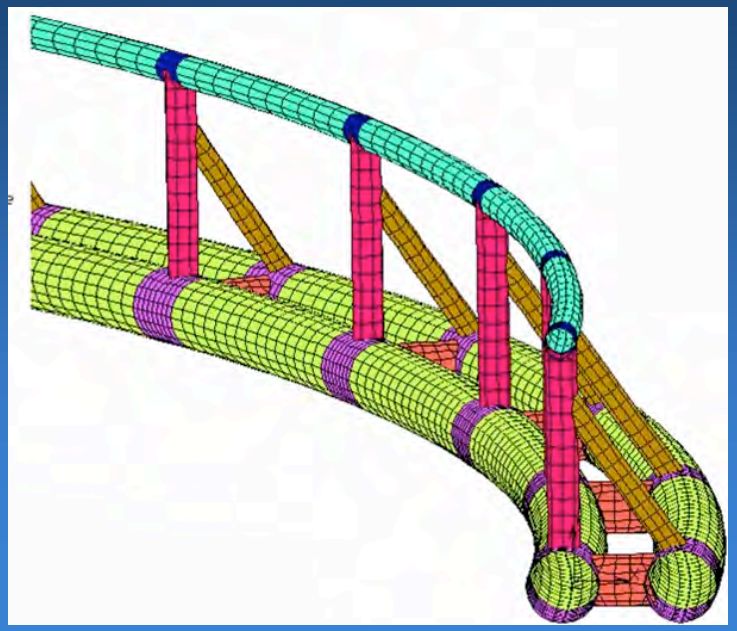


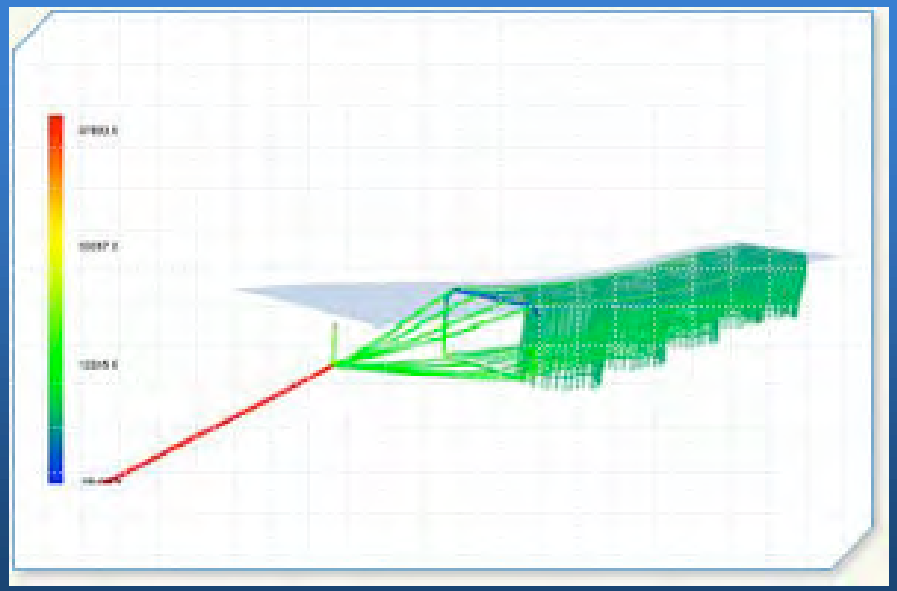


Computer simulation and Scale Model Testing



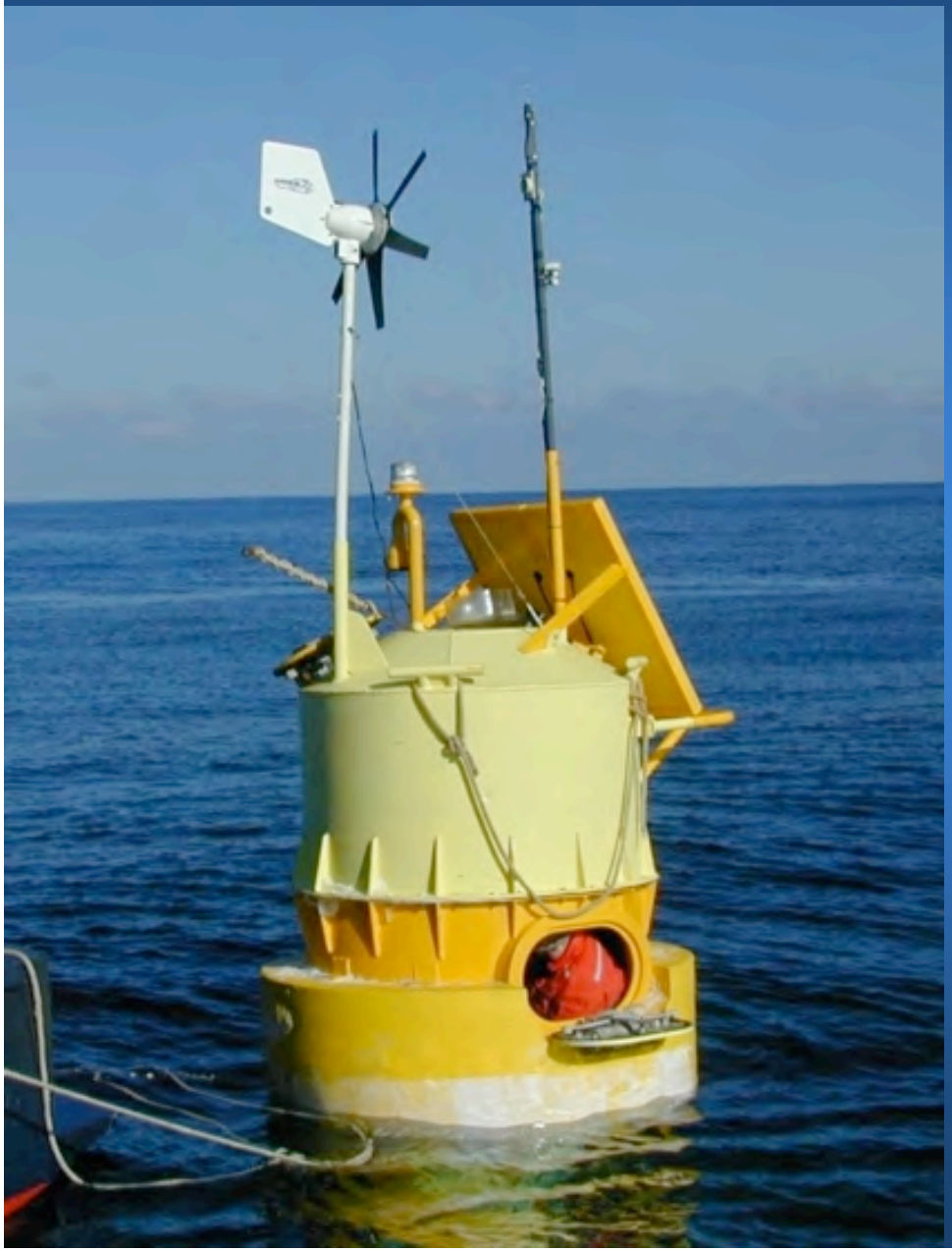


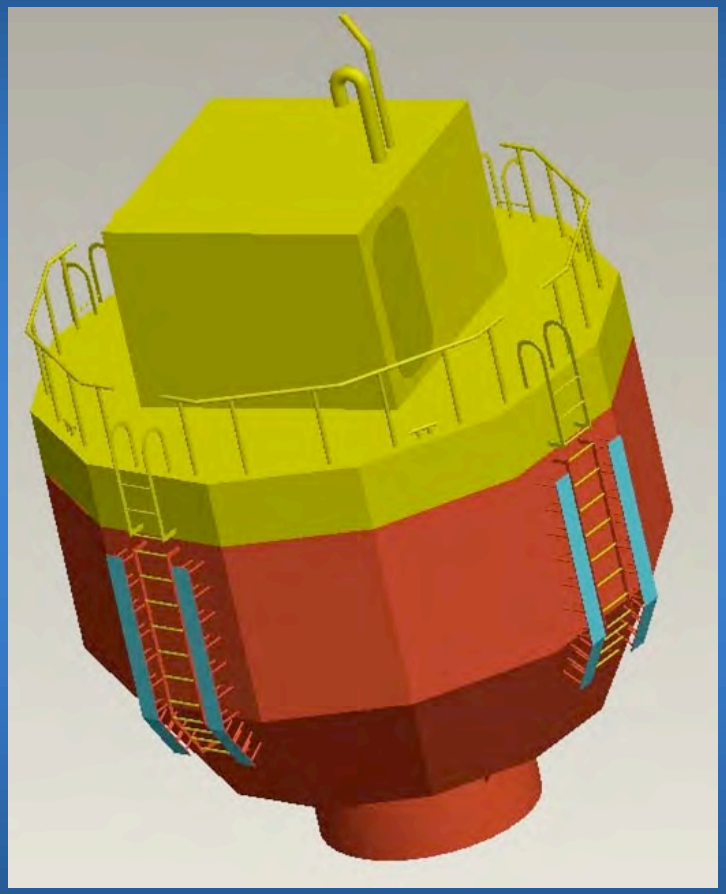


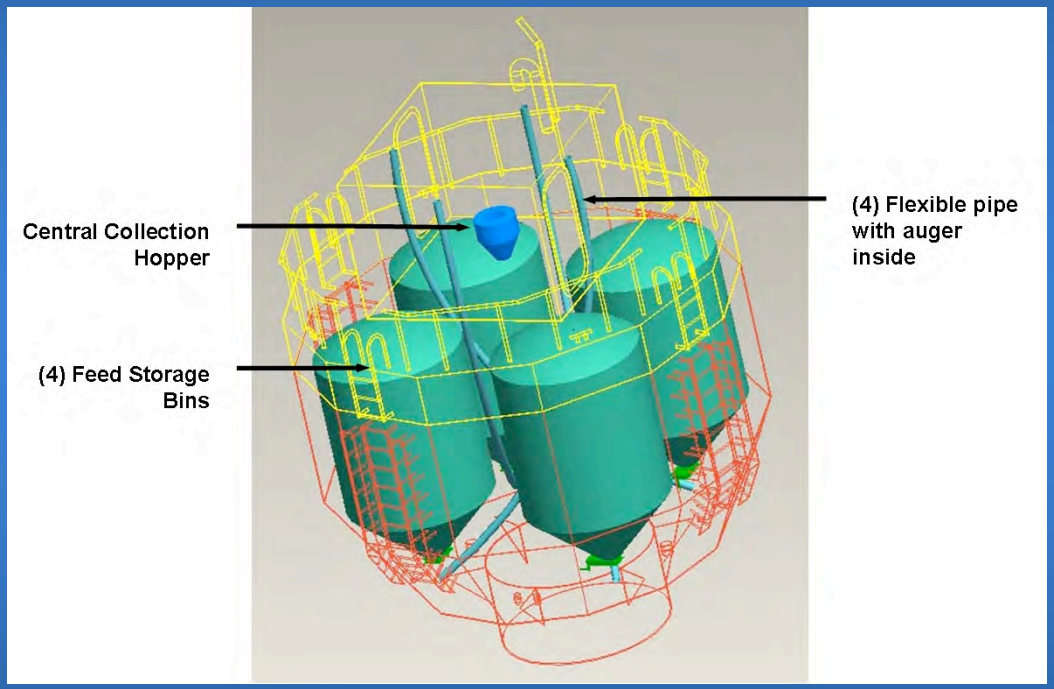



Top
Superstructure
Ballast Ring
Airlift
Ballast Weight

Remotely controlled automated feeding systems

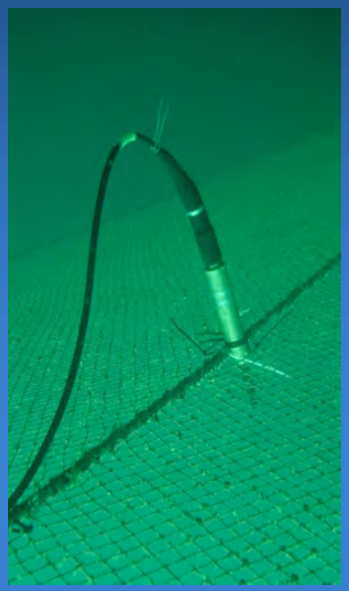


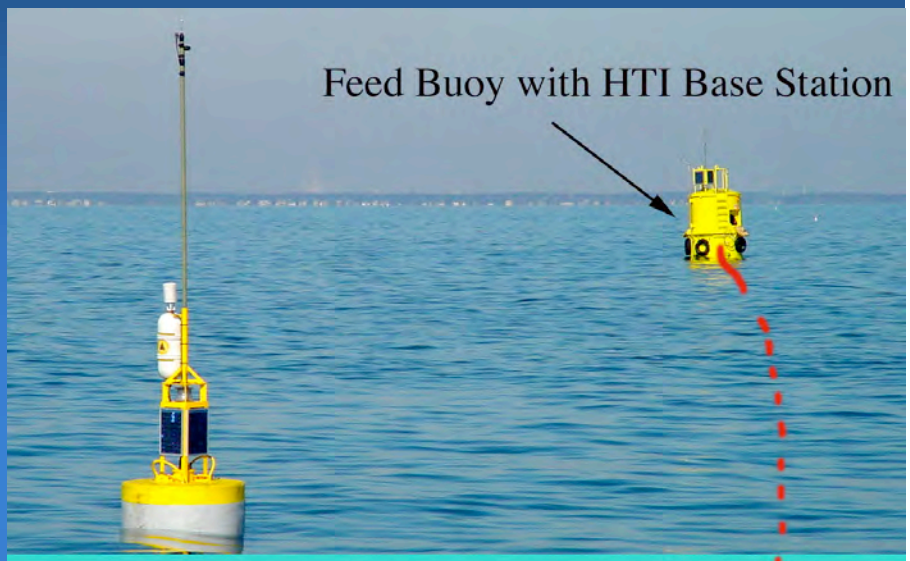


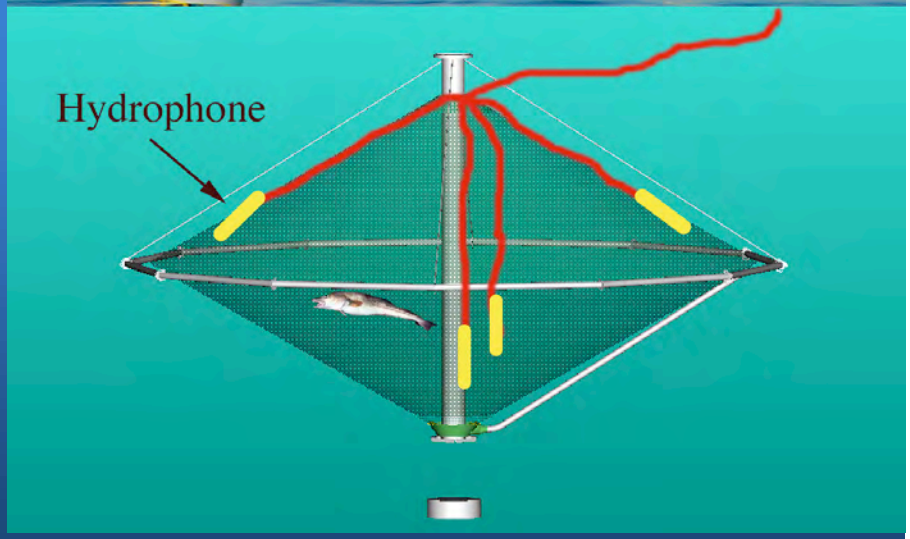

Central Collection Hopper
(4) Feed Storage Bins
(4) Flexible pipe with auger inside


Remote Data Acquisition and Control

Acoustic Tracking

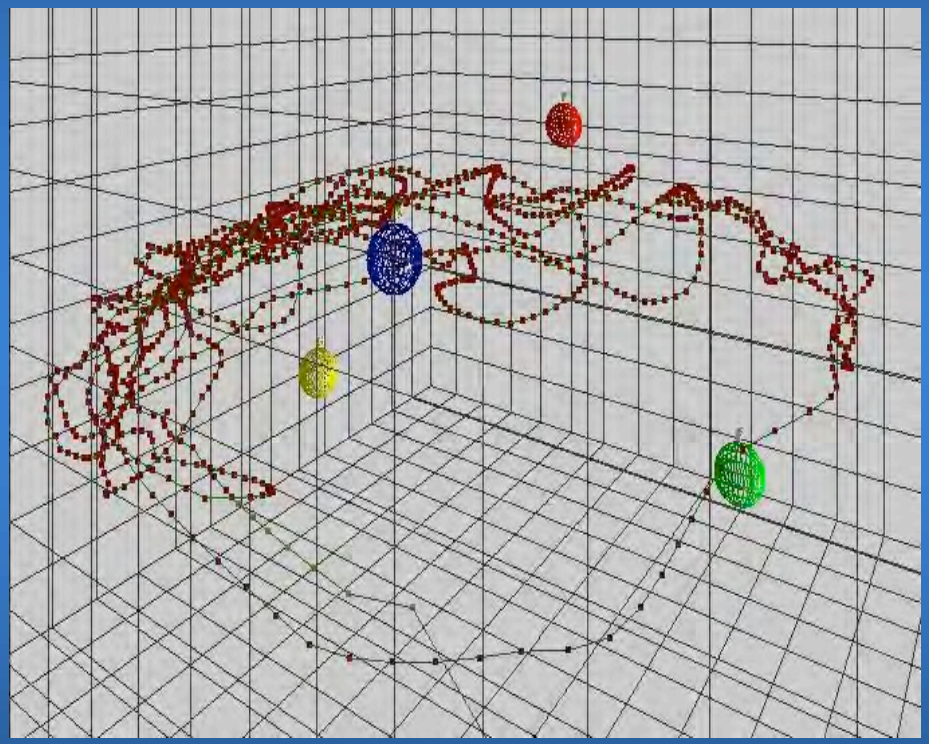




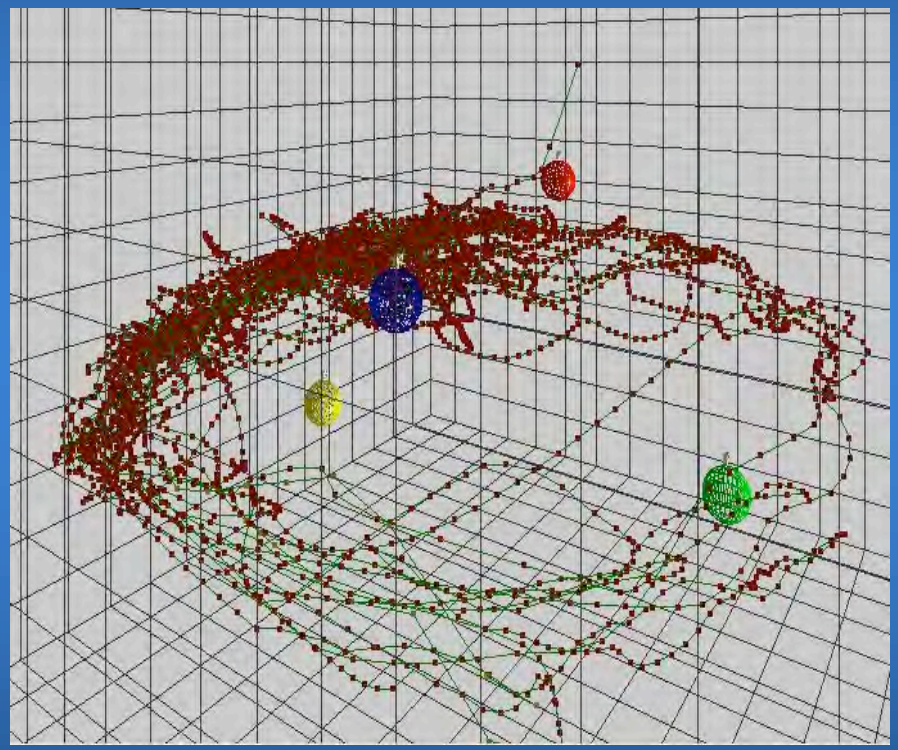


- *Continuous recording*
- *Up to 16 fish at a time*
- *Wireless comm with CPU in feed buoy*
- *Continuous environmental monitoring*
  - *current meter*
  - *temperature recorders*
  - *UW video*

Fish Tracks



One cod tracked



Five cod tracked

Summer Flounder- Seasonal 1999 and 2000


POSEIDON

Finfish + Bivalves = Integrated Aquaculture

Feed Addition

Metabolism

65-87%

Dissolved Nitrogen (NH4)

Increased Primary Production

Uneaten food

3-10%

Fish feces

10-25%

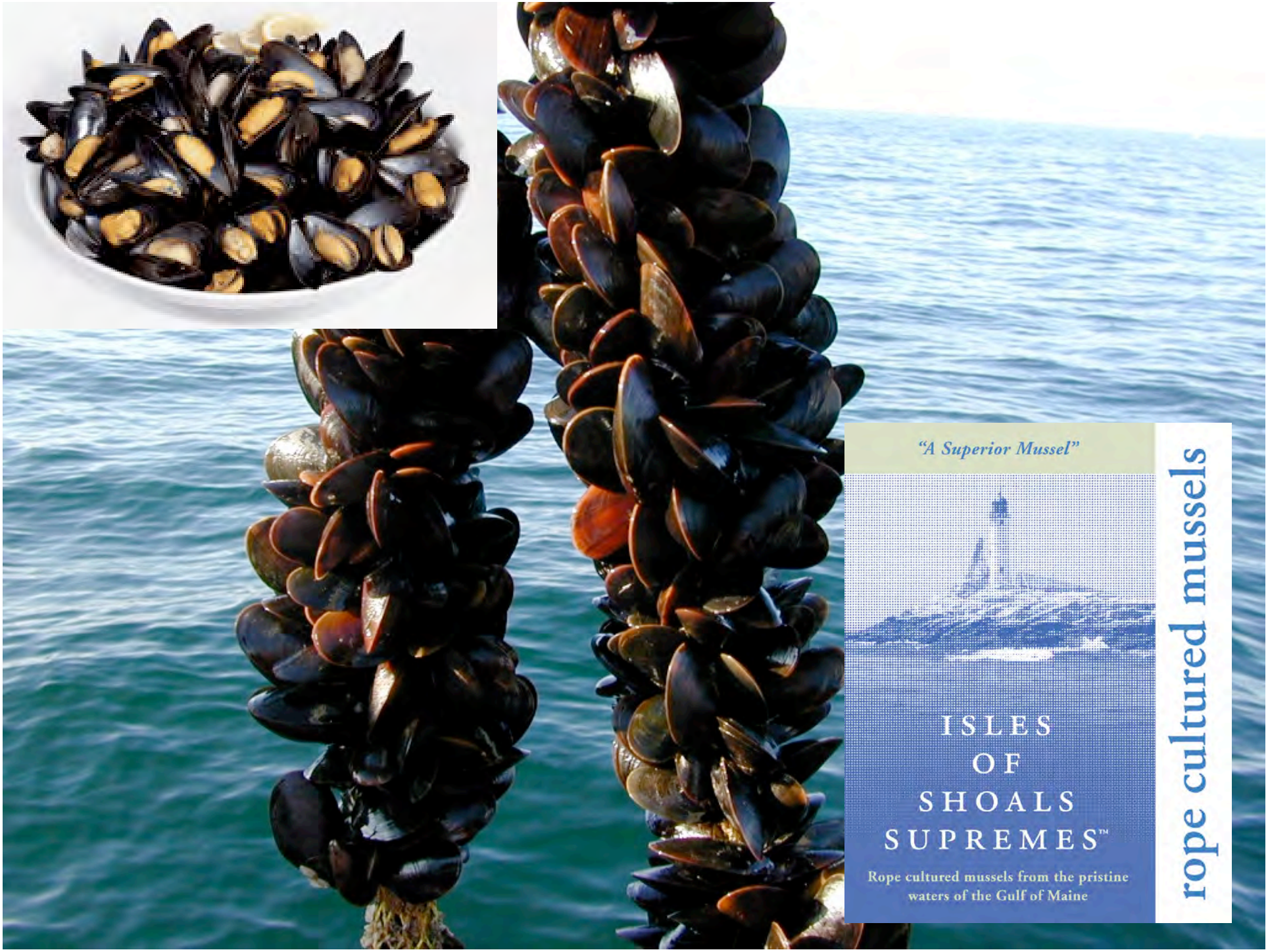
Bivalve Culture and Removal via Harvest

Decomposition and Remineralization

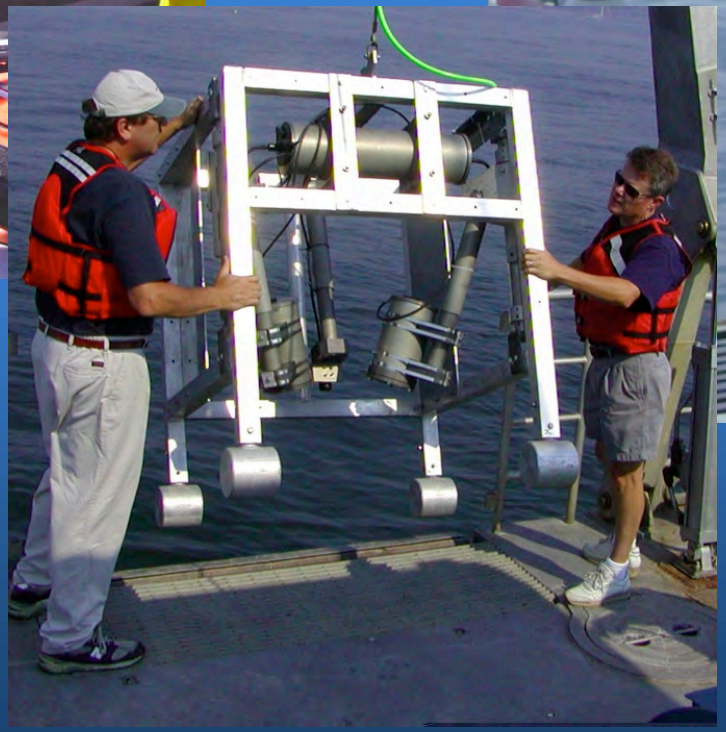
Denitrification


REEFGEAR


Renaissance
5908


"A Superior Mussel"
ISLES
OF
SHOALS
SUPREMES™
Rope cultured mussels from the pristine waters of the Gulf of Maine
rope cultured mussels

Demonstrating Environmental Stewardship



Resource Enhancement

Shellfish

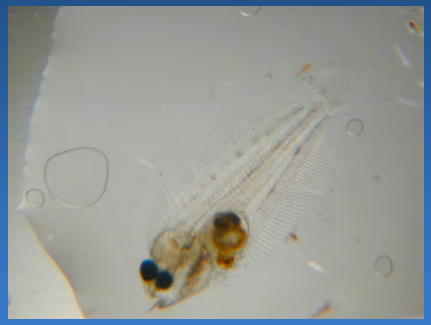
- ***Softshell Clams- Maine, Massachusetts***
- ***Eastern oysters- New Hampshire, Rhode Island***
- ***Bay scallop restoration- New York, Connecticut and Massachusetts***

Finfish

- ***Long history of enhancement efforts***
- ***Atlantic Cod- fertilized eggs and larvae, Federal fisheries labs***
- ***Atlantic Salmon-US Fish and Wildlife, States of Maine and NH***
- ***Pacific Salmon- State of New Hampshire***
- ***Research on winter flounder- Univ. of NH***

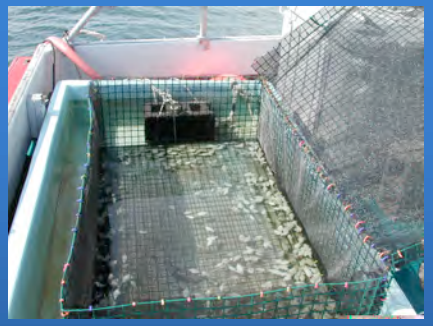
Winter Flounder Enhancement

Hatchery Technology



Nutrition

Tagging



Conditioning

Release Strategies and survival assessment

Future Prospects-Shellfish Culture

- *Good potential for expansion*
  - *Strong market demand*
  - *Continues to gain environmental acceptance*
  - *Offshore opportunities*
  - *Recognition of role for shellfish culture in Integrated Coastal Management*
  - *Opportunities for integrated aquaculture*
  - *Alternative for commercial fishermen*
- *Impediments to growth*
  - *Pollution- coastal development/NPS*
  - *Social resistance due to demographic change*
  - *Multiple use conflicts*
  - *Predation*
  - *Disease*

Future Prospects-Land based finfish culture

- *Modest expansion possible*
  - *Flatfish, barramundi, other??*
  - *Technology continues to improve incrementally*
- *Impediments to growth*
  - *Land, labor and energy costs*
  - *Limitation on the number of appropriate species*

Future Prospects-nearshore netpen finfish culture (salmon)

- *U.S. Expansion possible but questionable*
- *Impediments to expansion*
  - *Regulatory constraints*
  - *Environmental and social resistance*
  - *Negative press and public opinion*
  - *Foreign competition*
  - *Space limitation and competing uses*

Future Prospects-offshore netpen finfish culture

- *Opportunity*
  - *Excellent environmental conditions*
  - *Technological advances- cages, feeders, etc.*
  - *Integrated Engineering -energy, people, fish*
  - *Ecosystems Approach to Development*
    - *Environmental, social and economic compatibility*
  - *DOC Legislation*
- *Impediments*
  - *Regulatory framework absent*
  - *Technological challenges remain*
  - *Infrastructure lacking- fingerling supply, feeds, OTS systems*
  - *Government R&D inadequate*
  - *Economic uncertainty- investment*
  - *Social compatibility*


Thank You
Any Questions?
http://ooa.unh.edu